providing a polarization medium; and

positioning the polarization medium in line with the light beam of the light source so that the linear polarization medium selects and attenuates each of the at least two polarization states equally or substantially equally.

Remarks

The preceding amendments and following remarks are submitted in response to the Official Action of the Examiner mailed May 22, 2002. Claims 1, 4, 5, 9, 10, 15, 17, 18 and 20 have been amended, and claims 21-22 have been added, leaving claims 1-22 pending in the application. Entry of this amendment and reconsideration by the Examiner to that end is respectfully requested.

In paragraph 3 of the Office Action, the Examiner objected to Figure 2 because it does not include a "Prior Art" designation. In response, Figure 2 has been amended to include a "Prior Art" designation. A red-line copy of Figure 2 is enclosed herewith for approval by the Examiner.

The Examiner also objected to the drawings because they fail to show the (100) and (011") directions as described in the specification. The Examiner states that showing the (100) and (011") directions is essential for a proper understanding of the disclosed invention, and therefore, should be shown in the drawings. Applicants must respectfully disagree that showing the (100) and (011") directions in the drawings is necessary for a proper understanding of the invention. First, one skilled in the semiconductor manufacturing art, and more specifically, the VCSEL manufacturing art would be intimately familiar with the various crystalline directions, and the relationships therebetween. Therefore, showing all of the crystalline directions in Figure 2 would not be necessary for a proper understanding of the invention. Second, and for purposes of this invention, one skilled in the art would recognize that the direction (100) may be interchangeable with (001), and (011) may be interchangeable with (011"). In view of the foregoing, Applicants believe that Figure 2 fully complies with 37 C.F.R. § 1.83(a).

In paragraph 6 of the Office Action, the Examiner rejected claims 1-14 under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim

the subject matter which Applicants regard as the invention. Regarding claim 1, the Examiner states that the phrases "an inherent polarization characteristic" and "adapted to" render the claims indefinite, and that the limitation "to select and attenuate the polarization characteristic equally" is vague and indefinite. Although Applicants respectfully disagree that claim 1 is indefinite, claim 1 has been amended to more clearly recite the invention.

In paragraph 8 of the Office Action, the Examiner rejected claims 1-19 as being anticipated by U.S. Patent No. 5,331,654 to Jewell et al. Regarding to claim 1, the Examiner states that Jewell et al. suggest a polarization controlled optical energy source comprising a laser source element having a polarization characteristic and a polarization medium positioned in proximal relation to the laser source element to select and attenuate the polarization characteristics equally.

After careful review, Applicants respectfully disagree that claims 1-19 are anticipated by Jewell et al. Jewell et al. do not appear to suggest a laser source element that has an inherent polarization characteristic, and a polarization medium that is adapted to select and attenuate the polarization characteristic equally, as recited in claim 1. Instead, Jewell et al. attempt to produce a laser source element that has a single polarization by treating the polarizations unequally. That is, Jewell et al. appear to providing a single polarization by introducing a preference for one polarization while attenuating the others (see, for example, Jewell et al., column 4, lines 30-32, 38-39). Jewell et al. state:

> "...anisotropy is introduced into the optical cavity or the active layer 26 so as to control the polarization of the beam of light emitted by the laser 10." ('654; col. 3; lines 51-54).

> "...By introducing anisotropy into the optical cavity or the active layer, the gain to loss ratio can depend upon the polarization state of the light, and the polarization of the emitted beam can be controlled. ..." ('654; col. 4; lines 15-18).

> "Anisotropy in the laser cavity can be introduced into the materials comprising the laser. There are many ways in which material anisotropy in the optical cavity can give preference to one polarization state. If the material is birefringent, i.e., having different refractive indices for light polarized in different orientations, the cavity resonance will occur at different wavelengths for the two polarizations. One of

> these wavelengths will have greater overall gain in the cavity and will therefore be preferred. Thus one polarization state will be preferred and will dominate the lasing action." (Jewell et al.; col. 4; lines 29-36).
>
> "When anisotropic structure 68 is etched into the top surface 37 of the semiconductor laser 10, the overlying material is most likely air, or it could be a liquid, or it could be a solid material, such as an epoxy. Light polarized linearly along the grating lines will be absorbed more strongly than light polarized perpendicular to the lines 70. The grating shown in FIG. 7 would therefore emit light polarized linearly in the vertical direction." (Jewell et al.; col. 7; lines 19-27).

(Emphasis Added). As can be seen, Jewell et al. suggest introducing anisotropy into the optical cavity or the active layer of a VCSEL to give a preference to one polarization state over the others, resulting in a single polarization light emission. As such, Jewell et al. clearly do not suggest providing a polarization medium that is adapted to select and attenuate the polarization characteristic equally, as recited in claim 1.

Despite the foregoing, and because of the Examiner's 35 U.S.C. § 112, second paragraph rejection, claim 1 has been amended to recite:

> 1. (Amended) A polarization controlled optical energy source comprising:
>
> a laser source element [having an inherent polarization characteristic] that produces a light output that has one and/or both of at least two polarization states; and
>
> a polarization medium positioned in proximal relation to the laser source element for [and adapted to select and attenuate the polarization characteristic] selecting and attenuating each of the at least two polarization states equally or substantially equally.

As can be seen, claim 1 recites a laser source element that produces a light output that has one and/or both of at least two polarization states. Claim 1 further recites a polarization medium for selecting and attenuating each of the at least two polarization states equally or substantially equally. Clearly, Jewell et al. does not suggest selecting and attenuating each of the at least two polarization states equally or substantially equally. Rather, and as noted above, a purpose of Jewell et al. appears to be to treat the various polarization states unequally - by providing a

preference for one polarization states to the exclusion of the others. For these and other reasons, Applicants believe the claim 1 is clearly patentable over Jewell et al. For similar and other reasons, claim 15 and dependent claims 2-14, and 16-19 are also believed to be clearly patentable over Jewell et al.

Specifically with respect to claim 4, the Examiner states that Jewell et al. suggests providing a laser source element that has multiple distinct polarizations oriented with respect to one another at angular intervals (citing Jewell et al., column 4, lines 33-36 and Figure 10. After careful review, the Examiner appears to be taking column 4, lines 33-36 of Jewell et al. out of context. Column 4, lines 33-36 state: "[i]f the material is birefringent, i.e., having different refractive indices for light polarized in different orientations, the cavity resonance will occur at different wavelengths for the two polarizations". Immediately following this passage, however, Jewell et al. state "[o]ne of these wavelengths will have greater overall gain in the cavity and will therefore be preferred. Thus, one polarization state will be preferred and will dominate the lasing action". When read as a whole, it is clear that Jewell et al. suggest modifying the VCSEL structure to produce anisotropy in the optical cavity to produce a light emission that has a single polarization state.

In view of the foregoing, it is clear that Jewell et al. does not suggest providing a laser source element that produces a light output that has one and/or both of at least two polarization states, as recited in claim 1, wherein the multiple distinct polarization states are oriented with respect to one another at angular intervals, as recited in claim 4. Instead, it appears that a goal of Jewell et al. is to provide a light source that has a single polarization state.

Specifically with respect to claim 5, the Examiner states that Jewell et al. suggests a polarization medium that is aligned to provide linear polarization along an axis that equally selects and attenuates the distinct polarizations (citing Jewell et al., column 8, lines 25-30). The Examiner uses the same paragraph of Jewell et al. to reject claim 10. After careful review, it appears that the cited paragraph of Jewell et al. is discussing why polarization control is needed in VCSEL devices. The solution proposed by Jewell et al. does not include providing a polarization medium that is aligned to provide linear polarization along an axis that equally

selects and attenuates the distinct polarizations, as recited in claim 5. Instead, and as noted above, a goal of Jewell et al. appears to be to treat the various polarization states unequally - by providing a preference for one polarization states to the exclusion of the others. While the remaining dependent claims are not specifically addressed herein, each of these dependent claims include additional features that further distinguish them from Jewell et al.

In paragraph 10 of the Office Action, the Examiner rejected claim 20 as being unpatentable over U.S. Patent No. 5,331,654 to Jewell et al. in view of U.S. Patent No. 5,761,229 to Baldwin et al. The Examiner states that Jewell. et al. suggest a package base, having a first self-aligning feature formed therein for indicating an alignment axis, and a vertical cavity surface emitting laser (VCSEL) having two emission polarizations normal to one another disposed upon the package base and aligned such that each emission polarization is at about 45 degrees with respect to the alignment axis.

After carefully review, Applicants must respectfully disagree that claim 20 is unpatentable over Jewell et al. in view of Baldwin et al. Claim 20 recites:

> 20. (Amended) A vertical cavity surface emitting laser component comprising:
>
> a package base, having a first self-aligning feature formed therein for indicating an alignment axis, the alignment axis not necessarily being in-line with the self-aligning feature;
>
> a vertical cavity surface emitting laser device, having at least two emission polarization[s] states normal to one another, disposed [upon] adjacent the package base and aligned such that each emission polarization state is at about 45 degrees with respect to the alignment axis;
>
> a package cover, having a second self-aligning feature and an upper surface aperture formed therein, coupled to the package base such that the first and second self-aligning features matably engage; and
>
> a linear polarization element, having a polarization direction, spanning the aperture and disposed such that the polarization direction is parallel or substantially parallel to the alignment axis.

(Emphasis Added). As noted above, Jewell et al. do not suggest a vertical cavity surface emitting laser device that has at least two emission polarization[s] states normal to one another. Rather,

Jewell et al. appear to suggest providing a VCSEL that has a single polarization state. In addition, Jewell et al. do not appear to suggest a linear polarization element having a polarization direction that spans the aperture and is disposed such that the polarization direction is parallel or substantially parallel to the alignment axis. Nor do Jewell et al. appear to disclose a package base having a self-aligning feature or a package cover having a second self-aligning feature, or other features, as recited in claim 20.

Baldwin et al. appear to describe various mechanisms for diverting a fraction of a VCSEL's emission to a monitoring photodiode. More particularly, '229 states:

> "In this embodiment, and in all of the embodiments described in this disclosure, accurate control of the intensity of the light beam 119 by the control circuit 127 depends on the coupler 114 having a fixed transfer function between the radiated light beam 107 on one hand and the reflected light beam 117 and the output light beam 119 on the other hand. Since the reflectivity of the coupler's beam-splitting surface, which is a boundary such as a glass-air boundary, a quartz-air boundary, or a plastic-air boundary, or such boundaries coated with a metallized reflection-control layer, depends on the direction of polarization of the radiated light beam, it is important that the VCSEL 101 generate the radiated light beam with a defined direction of polarization to provide the coupler with a fixed transfer function. Otherwise, variations in the direction of polarization of the radiated light beam would cause the transfer function of the coupler to change. Any change in the transfer function of the coupler due to a change in the direction of polarization would cause the control circuit to change the intensity of the radiated light beam (and, hence of the output light beam) unnecessarily." (Baldwin et al.; col. 11; lines 3-22)

(Emphasis Added) As can be seen, Baldwin et al. appear to suggest that in order for their invention to be useful, "... it is important that the VCSEL 101 generate the radiated light beam with a defined direction of polarization ...". It is true that the laser provided by Jewell et al. may satisfy this requirement. However, it is clear that neither Jewell et al. or Baldwin et al. suggest many of the elements of claim 20 including, for example, a vertical cavity surface emitting laser device that has at least two emission polarization states normal to one another, a linear polarization element having a polarization direction that spans the aperture and is disposed such that the polarization direction is parallel or substantially parallel to the alignment axis, a package base having a self-aligning feature or a package cover having a second self-aligning feature, and

others. In view thereof, claim 20 is believed to be clearly patentable over Jewell et al. in view of Baldwin et al.

Applicants have added newly presented claims 21-22 for consideration by the Examiner. For the reasons set forth above, and other reasons, Applicants believe that newly presented claims 21-22 are clearly in condition for allowance.

Having thus addressed the Examiner's grounds for rejections, Applicants believe pending claims 1-22 are clearly in condition for allowance. Reconsideration to that end is respectfully requested. If a telephone conference might be of assistance, please contact the undersigned attorney at 612-677-9050.

Respectfully submitted,

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By their attorney,

Date August 22, 2002

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Version with Markings to Show Changes Made

In the Claims

Claims 1, 4, 5, 9, 10, 15, 17, 18 and 20 have been amended as follows:

1. (Amended) A polarization controlled optical energy source comprising:

a laser source element [having an inherent polarization characteristic] that produces a light output that has one and/or both of at least two polarization states; and

a polarization medium positioned in proximal relation to the laser source element for [and adapted to select and attenuate the polarization characteristic] selecting and attenuating each of the at least two polarization states equally or substantially equally.

4. (Amended) The source of Claim 3, wherein said laser source element has multiple distinct polarization[s] states oriented with respect to one another at angular intervals.

5. (Amended) The source of Claim 4, wherein said polarization medium is aligned to provide linear polarization along an axis that equally selects and attenuates the distinct polarization[s] states.

9. (Amended) The source of Claim 8, wherein said laser source element has two distinct polarization[s] states that are normal to one another.

10. (Amended) The source of Claim 9, wherein said polarization medium is aligned to provide linear polarization along an axis that is at about 45 degrees to both distinct polarization[s] states.

15. (Amended) A method for VCSEL polarization control comprising the steps of:

providing a VCSEL element [having an inherent polarization characteristic] that produces a light output that has one and/or both of at least two polarization states;

providing a polarization medium; and

positioning the polarization medium in proximal relation to the [laser source] VCSEL element to select and attenuate [the polarization characteristic] each of the at least two polarization states equally or substantially equally.

17. (Amended) The method of Claim 16, wherein the step of providing a VCSEL element further comprises providing a VCSEL element having two distinct polarization[s] states that are normal to one another.

18. (Amended) The method of Claim 17, wherein the polarization medium is aligned to provide linear polarization along an axis that is at about 45 degrees to both distinct polarization[s] states.

20. (Amended) A vertical cavity surface emitting laser component comprising:

a package base, having a first self-aligning feature formed therein for indicating an alignment axis, the alignment axis not necessarily being in-line with the self-aligning feature;

a vertical cavity surface emitting laser device, having at least two emission polarization[s] states normal to one another, disposed [upon] adjacent the package base and aligned such that each emission polarization state is at about 45 degrees with respect to the alignment axis;

a package cover, having a second self-aligning feature and an upper surface aperture formed therein, coupled to the package base such that the first and second self-aligning features matably engage; and

a linear polarization element, having a polarization direction, spanning the aperture and disposed such that the polarization direction is parallel or substantially parallel to the alignment axis.